

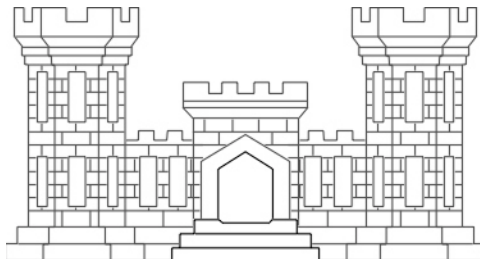
**PRELIMINARY DRAFT
ENVIRONMENTAL ASSESSMENT**

**CENTER HILL RESERVOIR, TENNESSEE
WATER SUPPLY STORAGE REALLOCATION**

November 2001

For Further Information, Contact:

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Acronyms and Abbreviations

BMPs	Best Management Practices
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CEQ	Council for Environmental Quality
Corps	U.S. Army Corps of Engineers
DOE	Department of Energy
EA	Environmental Assessment
EO	Executive Order
EPA	Environmental Protection Agency
ERGO	Environmental Review Guide for Operations
FWCA	Fish and Wildlife Coordination Act
mgd	million gallons per day
mg/L	milligrams per liter
M&I	Municipal and Industrial
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NERR	Nashville & Eastern Railroad
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NPDES	National Pollutant Discharge Elimination System
NWI	National Wetland Inventory
O&M	Operations and Maintenance
RM	River Mile
SEPA	Southeastern Power Administration
SHPO	State Historic Preservation Officer
TEAM	The Environmental Assessment and Management
TDEC	Tennessee Department of Environment and Conservation
TDNH	Tennessee Division of Natural Heritage
TSI	Trophic State Indices
TVA	Tennessee Valley Authority
TWRA	Tennessee Wildlife Resources Agency
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

EXECUTIVE SUMMARY

Center Hill Reservoir is situated in a four-county area in central Tennessee. The authorized purposes of the reservoir are flood control and hydropower production. This region has experienced significant population and industrial growth in the past decade, and the area continues to enjoy the prosperity associated with this growth. A result of this growth has been a significant demand and increase in the water needs of the population. To meet the finished water needs of the Municipal and Industrial (M&I) users, two municipalities, a utility district, and a private entity have requested additional withdrawals from Center Hill Reservoir. In January 2000, the Nashville District, U.S. Army Corps of Engineers (Corps) completed an evaluation in response to the requests for water withdrawal from the reservoir. The findings determined that sufficient water exists in the reservoir to meet the requests of the M&I water users on an interim basis, while still fulfilling the operating objectives of the reservoir.

The current Environment Assessment (EA) is being prepared to evaluate the impacts of permanent reallocation of storage in Center Hill Reservoir from one of the originally authorized purposes to that of water supply. Reallocation of storage on a permanent basis would entail designating a portion of the available storage in the reservoir for M&I water withdrawals. Parties wishing to use any of this storage would be required to enter into a contract with the government to purchase sufficient storage to meet their current and anticipated needs. The water supply reallocation contract is for storage necessary to provide a specific yield with 98% reliability during a 50-year drought. The contract fee is for a one-time purchase of storage in the reservoir plus annual payments for a prorated share of operation and maintenance costs associated with storing water in the reservoir. In addition, the Corps recommends that each M&I user establish a sinking fund to cover future repair and rehabilitation to the project. Permanent reallocation of storage for water supply is authorized by Title III of Public Law 85-500 known as the 1958 Water Supply Act.

This EA was prepared pursuant to the National Environmental Policy Act (NEPA), Council for Environmental Quality (CEQ) regulations implementing NEPA (40 CFR, 1500-1517), and Corps of Engineers Regulations ER 200-2-2 Policy and Procedures for Implementing NEPA (33 CFR, 230). The EA was prepared to describe existing conditions and evaluate potential impacts associated with the proposed action and alternatives. The two alternatives considered in this EA are permanent reallocation of storage and "no action." "No action" would result in no permanent reallocation of storage for water supply and would require current and future users to develop other sources of water.

Agency coordination and compliance issues have been identified and initial contacts made with the appropriate agencies. Input on scoping and public concern issues have also been solicited and considered in preparation of the EA.

Natural resources, including water quality, were evaluated through a site visit, interviews, and by using historical data from a variety of sources. The Proposed Action of reallocating water storage is not expected to significantly impact the natural resources of the reservoir. Under conditions similar to the drought of record, the reservoir drawdown expected would be

approximately 0.5 foot, and only locales having very shallow water could experience some temporary loss of aquatic habitat from the fluctuating water level. This area would be very small when compared to the available habitat of the entire reservoir, and any temporary loss of habitat would not significantly impact the aquatic community of Center Hill Reservoir.

Protected species on either federal or state lists near the study area would not be affected by the Proposed Action since they are located out of the influence of the water level fluctuations.

The Proposed Action is the best and most cost-effective approach to meet the water needs of the M&I users in the region.

In summary, the Proposed Action:

- would provide M&I water users with a safe and reliable supply of water

- would allow M&I users to meet existing and future water requirements in a cost-effective manner

- would establish a share of the operation, maintenance, repair, and replacement costs of Center Hill Reservoir to be paid by M&I users

- would increase the average monthly cost for a typical family of four about \$0.25, approximately

- is environmentally sensitive to the resources in the area and would not significantly or cumulatively impact any natural or cultural resources or other elements of the human environment

- would result in a reservoir drawdown that is expected to be about 0.5 foot, which is in the normal operating range of the reservoir

- would not significantly impact flood control and hydropower, which are authorized purposes of Center Hill Reservoir

1.0 INTRODUCTION

The United States Army Corps of Engineers' (Corps) role in managing water supply originated with Public Law 78-534 (1944 Flood Control Act), which authorized the Secretary of the Army to enter into surplus water agreements for domestic, municipal, and industrial (M&I) uses. The subsequent Public Law 85-500 (1958 River and Harbor Act) gave the Corps authority to include M&I water storage in reservoir projects and to reallocate storage in existing reservoirs from other uses to M&I uses, providing that the project's objectives are not seriously affected. Throughout the United States, the Corps has about 240 domestic and M&I water supply contracts spread over 117 different projects, accounting for several million acre-feet of storage.

The Nashville District of the Corps has allowed over 60 M&I water intakes to be placed in the ten reservoirs under its jurisdiction without having water supply contracts. The only contract in the Nashville District was with the City of Cookeville, Tennessee, and expired March 31, 1998. The Corps recognizes that the long-term solution is to permanently reallocate some reservoir storage for M&I water supply and that hydrological studies will need to be completed to evaluate the water reallocation.

The existing conditions and potential impacts of the proposed alternative of water reallocation for Center Hill Reservoir are presented in this Environmental Assessment (EA). The EA was prepared pursuant to the National Environmental Policy Act (NEPA) Council for Environmental Quality (CEQ) regulations (40 CFR, 1500-1517) and the Corps implementing regulation, Policy and Procedures for Implementing NEPA, ER 200-2-2, 1988.

2.0 PURPOSE OF AND NEED FOR ACTION

2.1 NATURE OF THE PROBLEM

Center Hill Reservoir is located in central Tennessee approximately 55 miles east of Nashville and encompasses portions of DeKalb, Putnam, White, and Warren Counties, Tennessee (Figure 1). Nearby population centers include Smithville, Cookeville, Sparta, and McMinnville. The project was constructed, and is in operation, for the primary purposes of flood control and hydroelectric power production. Secondary purposes include recreation, fish and wildlife conservation, and water quality. The reservoir covers a lake surface area of 18,220 acres surrounded by 20,330 acres of public lands at normal summer pool (elevation 648.0 feet above National Geodetic Vertical Datum [NGVD]).

Due to the growth in population in the vicinity of Center Hill Reservoir, water withdrawal proposals have been made, and more are anticipated, to meet the increasing water needs for M&I customers. Several adjacent municipalities and organizations have requested additional water storage withdrawals from Center Hill Reservoir for increasing finished water supply demands in the area. The Nashville District prepared the *Reallocation Report for Water Supply Storage on Center Hill Reservoir, Tennessee*, (Corps, 2001) (Reallocation Report) in order to bring existing users (the City of Cookeville, Tennessee and the City of Smithville, Tennessee) into compliance with the Water Supply Act of 1958 and in response to requests from the DeKalb Utility District, Tennessee, and RiverWatch Resort, LLC. for withdrawals. The report provides background information and addresses currently anticipated future water needs of other cities with some allowance for additional future users. Some of the cities and other entities have requested increased water withdrawal, while others have identified the need for a new water intake. The findings of the Corps report, incorporated herein by reference, provide the rationale for reallocating storage for the water supply while still fulfilling authorized purposes for the reservoir. In summary, the following entities, and the amount of water requested (projected to 2009) from Center Hill Reservoir include:

City of Cookeville, Tennessee – 20.0 million gallons per day (mgd) withdrawal (13.65 mgd return flow) from an existing 30-inch water intake and a proposed second 30-inch water intake on Mine Lick Creek Embayment (Cookeville currently withdraws 10.8 mgd)

Town of Smithville, Tennessee – 1.2 mgd withdrawal (1.56 mgd return flow, excess flow due to groundwater infiltration) from an existing intake near Sligo Bridge (Smithville currently withdraws 1.3 mgd)

DeKalb Utility District, Tennessee – 4.0 mgd (0.05 mgd return flow), from a proposed new intake to be located in the Holmes Creek cove of Center Hill Reservoir

RiverWatch Resort, LLC, Tennessee – 0.392 mgd (0.00 mgd return flow), from a new intake being constructed

Anticipated New Users or Increases by Existing Users – 2.559 mgd (0.00 mgd return flow), potentially from various locations

A total of 28.151 mgd would be withdrawn and 15.260 mgd would be returned.

The locations of existing water intakes are shown on Figure 2.

2.2 RESERVOIR OPERATIONS

Construction of Center Hill Reservoir was initiated in 1942 but the work was suspended from 1943 to 1946 due to World War II. Dam closure was completed in 1949. The first power unit was placed in commercial operation in 1950. Originally authorized project purposes were flood control and hydroelectric power production; management of water quality, fish and wildlife conservation, and recreation were later added. The project is currently managed and operated for all of these purposes.

The operation of Center Hill Reservoir is primarily governed by its purposes of flood control and hydroelectric power generation. Normal operation is within a range of 30 feet of water level change between the top of the power pool and spillway crest at 648.0 feet NGVD and minimum pool at 618.0 feet NGVD (Figure 3). This operational range provides a storage capacity of 492,000 acre-feet to accomplish power production objectives. The normal pool during the recreation season generally ranges from 640.0 feet NGVD to 648.0 feet NGVD. During high water periods, usually occurring in the winter and spring months, the top of the power pool is occasionally exceeded and flow will enter the flood control pool or pass downstream if conditions allow. The top of the flood control pool is at 685.0 feet NGVD (top of spillway gates) and provides an additional 762,000 feet of storage. During the history of the project, the pool has been within the range of the power pool over 92 percent of the time and within the flood control pool about eight percent of the time. The pool has never been below the bottom of the hydropower pool (618 feet NGVD).

In cooperation with the Tennessee Wildlife Resources Agency (TWRA), the pool level is stabilized in the spring to the extent practicable during a two-week peak fish-spawning period that is determined according to water temperature.

Intermittent releases are provided to the extent practicable during warm weather in order to improve water quality conditions for the cold water fishery in the tailwater.

2.3 ISSUES AND OPPORTUNITIES

The M&I water users in the project area are experiencing rapid population growth and an increased demand for water. The District has conducted an engineering water reallocation evaluation that presents several options for the various entities to meet the increased demand for water. This evaluation was prompted in part to bring existing users into compliance with the Water Supply Act of 1958 (Reallocation Report, Corps, 2001), and also in response to requests from the DeKalb Utility District and RiverWatch Resort, LLC. for withdrawals. The Reallocation Report addressed the additional water needs of the City of Cookeville, Tennessee, the City of Smithville, Tennessee, and estimates for other unidentified new water users. The additional water that would be withdrawn from Center Hill Reservoir would come from the storage capacity of the reservoir as it relates to the hydropower pool. Water stored in this pool also provides support for other uses including recreation, fish and wildlife, and water quality purposes.

Implementation of the Proposed Action accomplishes the following:

complies with the mandate for assessing storage charges in reservoirs as specified in Public Law 85-500

allows the cities and communities an opportunity to obtain storage to meet their growth demands in a cost-effective manner

balances water supply with the authorized purposes and other uses including flood control, hydropower production, recreation and fish and wildlife conservation; and with water quality management

distributes the proportional cost of operation and maintenance of the storage capacity portion among all joint users

provides water users permanent water storage

3.0 ALTERNATIVES CONSIDERED

Several alternatives for meeting the additional water needs requested were evaluated and dismissed from detailed consideration as described in the Reallocation Report and as summarized below:

City of Cookeville

The City of Cookeville is the largest urban center in the area and consequently needs a relatively large water supply source. City Lake was the source of water until it was replaced in the late 1960s by Center Hill Reservoir because of the lake's inability to support the increasing needs of the city's growth. The city currently has a water intake on Center Hill Reservoir.

Per the city it has no alternative sources of raw water that are economically feasible.

City of Smithville

The City of Smithville currently provides potable water to the DeKalb Utility District as well as to its residents. The city expects to be withdrawing 0.1 mgd less water in 2009 if it loses the DeKalb Utility District as a customer when they complete their own intake and water treatment plant. The city currently has a water intake on Center Hill Reservoir.

The city has examined using Morgan Springs as a water supply source. Testing of the springs indicates that it either has an inadequate capacity for the city's future water needs or that it is under the influence of surface water (these sources tend to dry up during drought periods as their source of water comes from runoff).

The city has also examined using water from Colvert Springs, Whorton Springs, Pine Springs, Cappy Springs, Fall Creek, and Pine Creek. Testing of the springs indicates that they are under the influence of surface water or that they have an inadequate capacity for the city's future water needs. An intake upstream of the city's wastewater treatment plant discharge on Fall Creek would not have sufficient capacity. Pine Creek was eliminated because Center Hill Reservoir was considered to be a more reliable source and more customers were located in the Center Hill Reservoir area.

DeKalb Utility District

DeKalb Utility District is currently purchasing potable water from the City of Smithville. The city has indicated that it lacks sufficient infrastructure capacity to deliver additional potable water to its customers and the district. The utility district proposes to construct a water treatment plant that will have storage capacity for 4.0 mgd by the year 2009 and to locate an intake structure in the Holmes Creek cove of Center Hill Reservoir. The utility district has applied for and received funding from the Rural Development Agency of the U.S. Department of Agriculture (USDA) to construct a new water treatment plant and related structures.

The utility district looked at using groundwater as an alternative water supply source. A detailed analysis indicated that groundwater yields for the amount required is very unreliable for the section of Tennessee in which the district is located.

The utility examined constructing a new dam and reservoir on either Caney Fork or Smith Fork to supply sufficient storage. However, the public does not support construction of a new dam and it would be very costly.

RiverWatch Resort, LLC

RiverWatch examined buying potable water from the DeWhite Water Utility District as a source of water for watering the golf course. This is not cost-competitive when compared to construction of an intake on Center Hill Reservoir. Since it will be used for watering a golf course, treatment of the water is unnecessary.

These alternatives were thoroughly evaluated from technical, permitting, and cost/benefit considerations and were not deemed feasible; therefore, they are not discussed further in this EA.

Based on the results of the evaluations described in the Reallocation Report, the two alternatives that are being considered are the Proposed Action (Water Supply Storage Reallocation), which would meet the current and projected demand for water, and the No-Action Alternative. Existing environmental conditions related to these alternatives and the potential impacts and cumulative effects resulting from the implementation of the Proposed Action and the No-Action Alternative are presented in this EA.

3.1 PROPOSED ACTION: WATER SUPPLY STORAGE REALLOCATION

Reallocated water supply storage would come from available storage in the reservoir determined considering the extreme drought conditions in the area for the period of record and the level of the hydropower pool for water supply. The contract would provide a specific yield with 98% reliability during a 50-year drought. The amount of storage that is needed by existing and future M&I users is 9,401.0 acre-feet based upon 28.151 mgd withdrawn and 15.26 mgd returned. Hydrologic studies for water supply reallocation determined that under 1953 drought conditions, at the top of the hydropower pool (648.0 feet NGVD), the water level drop from conditions unrelated to water supply, such as evaporation, water quality requirements, leakage, and minimum hydropower requirements would be 12.8 feet, to 635.2 feet NGVD. As proposed, 9,401 acre-feet of storage between 635.2 and 634.7 feet NGVD would be reallocated from the hydropower pool for water supply storage. Under this scenario, the reservoir drawdown for water reallocation that would be experienced during a critical drought is expected to be about 0.5 foot lower than without water supply. Water supply drawdown would be less at higher water levels.

M&I users would be required to enter into a contract to purchase water storage and pay a portion of future annual operations and maintenance (O&M) costs of Center Hill Reservoir. Storage costs are determined based upon the higher of:

hydropower benefits foregone – the lost benefits to electrical customers resulting from water being diverted from the reservoir for water supply rather than passing through a hydropower plant and a loss in dependable capacity at the project (due to loss of head or loss of full capacity during low-flow periods).

hydropower revenues foregone – the value of the lost power based on the marketing agency's current rates.

hydropower replacement – the cost of replacement power.

updated cost of storage – the portion of total project construction cost, updated to current price levels, which would be paid by each water supply user based on its percentage of the total storage reallocated for water supply.

3.2 NO-ACTION ALTERNATIVE

This alternative consists of no change in the current water storage allocation. No water would be allocated for water supply. Existing users would be forced to find alternate water supplies for M&I needs.

4.0 AFFECTED ENVIRONMENT

Center Hill Reservoir is located in central Tennessee approximately 55 miles east of Nashville, and encompasses portions of DeKalb, Putnam, White, and Warren Counties, Tennessee. Nearby population centers include Smithville, Cookeville, McMinnville, and Sparta. The dam is located at RM 26.6 on Caney Fork River, a 145-mile long tributary of the Cumberland River. At a pool elevation of 685.0 feet NGVD (maximum flood control pool), the reservoir has a shoreline length of 415 miles and extends 64 miles upstream to Great Falls Dam, a TVA dam. Center Hill Reservoir also extends ten miles up Falling Water River to the foot of Burgess Falls.

Center Hill Reservoir was formed along the deeply carved meandering valley of Caney Fork River and several of its major tributaries, including Falling Water River, Mine Lick Creek, Indian Creek, Holmes Creek, Fall Creek, Pine Creek, and Sink Creek. Stream dissection along tributary streams of the Caney Fork River has created a steep ridge and valley topography. The rough terrain surrounding the reservoir has slopes often exceeding 45 percent, and the irregular shoreline forms numerous deep narrow coves. In the lower section of the reservoir, however, some open areas are found with gradual slopes leading from the surrounding hillsides to the edge of the water. The reservoir is surrounded by a series of ridges and hills with predominantly secondary and tertiary growth, mixed mesophytic forests growing to the reservoir's shoreline. Flooded timber along the shoreline does not exist as all timber below 648.0 feet NGVD was cleared prior to impoundment.

The reservoir has a length of 63.6 miles with a surface area of 18,220 acres surrounded by 20,330 acres of public lands at the top of the hydropower pool or spillway crest (elevation 648.0 feet NGVD). At the minimum pool at 618.0 feet NGVD (top of inactive storage or minimum hydropower pool), the reservoir is 62.4 miles in length and has a surface area of 14,590 acres. Typically, during the course of the year, pool levels may fluctuate between 648 feet NGVD and 632 feet NGVD. The configuration of the shoreline does not differ appreciably with the level of the reservoir due to its steepness of the slopes, which varies from 20 to 30 percent slopes to sheer bluffs.

4.1 PHYSIOGRAPHY

Center Hill Reservoir is located within the Central Highlands Physiographic Province and across two physiographic regions. Approximately fifty percent of the reservoir area, including the main reservoir impoundment (north of US Highway 70) is located within the Central Basin Physiographic Region, while the remaining portion of the reservoir lies within the Highland Rim Physiographic Region.

The Central Basin is a nearly elliptical depression enclosed by the Highland Rim. The Central (or Nashville) Basin was formed by erosion of the Nashville Dome, a low structural dome that makes up the structural and geographic center of the Basin. The dome represents the southern end of the Cincinnati Arch, an elongated area of upwarped rocks that extends into Tennessee. During the upwarping and doming, the rocks at the crest of the dome were stretched, resulting in the formation of joints. The weakened carbonate rocks were readily

subject to solution and erosion, resulting in a topographic basin that now occupies the top of the structural dome. The Central Basin is characterized by flat-lying calcium carbonate sedimentary rocks of Ordovician age. These sedimentary rocks comprising the Central Basin include limestone, shale, dolomite, siltstone, sandstone, and claystone. Elevations within this region range from 500 feet to more than 800 feet above mean sea level.

The Highland Rim is a ring-shaped, level to rolling plateau area completely encircling the Central Basin that has been deeply dissected by streams. Many of the smaller stream valleys are marked by abrupt escarpments. This region extends from the western margin of the Cumberland Plateau southward and westward. In the deeper stream valleys, exposed rock formations are flat-lying limestones of Ordovician age, while Devonian shales occur along the boundary of the Central Basin. Elsewhere the formations consist of horizontal or gently dipping strata of limestones, cherts, shales, and sandstones of Mississippian age. Elevations within this region range from as low as 400 feet in the stream valleys to 1,000 feet above mean sea level on the plateau areas. This part of the Highland Rim is characterized by karst topography. Numerous rock outcrops and sinkholes are present in this region. Sinkholes are formed by the collapse of underground cavities dissolved out of limestone by the flow or percolation of subsurface water streams and seepages.

Erosional remnants of the Highland Rim extend into the Central Basin, indicating that it was once overlain by younger rocks of the Highland Rim. These erosional remnants, formed by resistant formations of Mississippian age, produced the rugged topography that characterizes the Center Hill Reservoir area.

4.2 AQUATIC RESOURCES

The information presented herein includes data from the following trophic levels: phytoplankton, benthic macroinvertebrates, and fish. Data are from July and September 1999 for phytoplankton sample analysis and phytoplankton trophic state indices analysis of samples taken from reservoirs in the Cumberland Basin from 1996 through 1999. A summary of benthic macroinvertebrate data from 1998 for five tributary streams of Center Hill Reservoir is presented. Fish species present in Center Hill Reservoir are listed in Appendix 3. Details of these studies are presented in Appendices 1-3 and are summarized in the following sections.

4.2.1 Phytoplankton

Phytoplankton are microscopic free-floating organisms that make up an important component of the aquatic ecosystem. They are primary producers, occupy the lowest trophic level in the food web within the aquatic environment, and are consumed by many types of higher life forms, including macroinvertebrates and fish. The general health and physical well-being of consumers are directly or indirectly dependent on phytoplankton.

In addition to the biotic relationships of phytoplankton, numerous abiotic factors are also of importance. Knowledge of phytoplankton species composition is useful in interpreting water quality and predicting potential problems concerning nuisance algal growths. Nuisance algae

can cause water taste and odor problems, and bio-fouling in filters, screens, pumps, and other types of water-handling equipment.

The results of the phytoplankton surveys are presented in Appendix 1. During both sampling periods analyzed, the number of taxa collected in the reservoir ranged from a low of 8 to a high of 19; and densities ranged from a low of 5 per milliliter to a high of 6,284 per milliliter at the same station in September 1997. The fluctuation in numbers of taxa and density are not uncommon and represent seasonal differences and differences in conditions between various portions of the reservoir. The taxa present in Center Hill Reservoir are common throughout all of the Cumberland River Basin reservoirs, and the communities that are present can be considered typical for the water body.

Total algal biovolumes for 1996 through 1999 were used to calculate Trophic State Indices (TSI). TSI of 35 to 50 indicate mesotrophic lakes; TSI below 35 are oligotrophic; and TSI above 50 are considered eutrophic. TSI at Center Hill Reservoir ranged from 41.5 to 46.3, which fall within the mesotrophic classification. The average for all the lakes sampled in the Cumberland Basin ranged from 41.0 to 43.7.

4.2.2 Benthic Invertebrates

Benthic invertebrates are bottom-dwelling organisms that are relatively sedentary and reflect the physical and chemical characteristics of their environment. The invertebrates thus reflect the overall ecological integrity and are indicative of environmental conditions. They serve as an important forage base for fish and other fauna.

An assessment was conducted in 1977 (Czarnezki) to evaluate the benthic macroinvertebrates within Center Hill Reservoir and provide information concerning species composition, standing crop, and community structure. Of the 92 taxa collected, 34 taxa were of the family Chironomidae. Oligochaetes were represented by 10 genera. The total number of benthic organisms was highest during late winter and lowest during the fall due to anaerobic conditions. The abundance of benthic macroinvertebrates increased with an increase in depth and longitudinally with the greatest standing crop occurring in the upstream portion of the reservoir. Fewer organisms were collected in littoral areas, which was attributed to exposure of the substratum during water level fluctuations. A majority of the dominant macroinvertebrates were tolerant and were adapted for survival in anaerobic waters.

More recent benthic macroinvertebrate assessments were completed in 1997 and 1998 of five tributaries of Center Hill Reservoir, along with the reservoir tailrace and a downstream tributary, where the primary objective of the benthic invertebrate studies was to evaluate the community structure of this trophic level so as to assess the quality of major and minor inflows to the reservoir. Results of the invertebrate sampling are presented in Appendix 2.

Collections indicate the invertebrate community is diverse and is comprised of a minimum of 214 taxa. Invertebrates are represented by both pollution-tolerant and sensitive organisms that are usually associated with cleaner, pollution-free water. While significant differences occur in species composition and relative abundance among the tributaries, many similarities also exist. Various combinations of Ephemeroptera, Trichoptera, and chironomids comprised

most of the invertebrate community at each location. Variations in relative abundance and composition accounted for differences among stations.

The invertebrate communities in the waterbodies sampled are diverse and are represented by different groups; and most major groups of invertebrates normally expected are represented in collections. All sites were fairly species rich and diverse with benthic faunas representative of good to very good water quality. However, it must be noted that populations of benthic macroinvertebrates in the tributaries and tailrace could be very different, in terms of both taxa occurrence and density, compared to populations in the reservoir.

Benthic invertebrate populations within the confines of Center Hill Reservoir have not been assessed recently by the Corps. Depth and seasonal depletion of dissolved oxygen along with physical habitat limitations would likely be the major factors controlling the distribution of benthic invertebrate populations within Center Hill Reservoir. Typically, profundal areas support organisms such as chironomids and oligochaetes, which are more tolerant of stressful environmental conditions. Benthic invertebrate populations within the shallower, littoral zones would be expected to have more representation by sensitive organisms.

4.2.3 Fish

The fish community is the highest trophic level of the aquatic resources, and is the most visible from the general public perspective. The primary objective of the assessment of the fish community is to identify what species are present and the relative abundance of important species. The TWRA Fisheries Division is responsible for fisheries resources as specified in Part 1 – Natural Resources Management of the Operational Management Plan for Center Hill Lake (Corps, October 1990).

Center Hill Reservoir contains diverse native and introduced species and the fisheries are typical of those found in similar reservoirs in Tennessee (Appendix 3). According to past creel censuses conducted by TWRA, the most important species harvested from the reservoir appear to include largemouth bass (*Micropterus salmoides*), smallmouth bass (*M. dolomieu*), and spotted bass (*M. punctulatus*), white and black crappie (*Pomoxis annularis*, *P. nigromaculatus*), bluegill (*Lepomis macrochirus*) and other species of sunfish (*Lepomis* spp.), walleye (*Stizostedion vitreum*), white bass (*Morone chrysops*), channel catfish (*Ictalurus punctatus*), blue catfish (*I. furcatus*), and flathead catfish (*Pylodictus olivaris*). In addition to these species, other important species of fish present at Center Hill Reservoir, based on data collected from cove rotenone samples, electrofishing, gill netting, and seining, appear to be gizzard shad and threadfin shad (*Dorosoma cepedianum*, *D. petense*), various minnows (Cyprinidae), carp (*Cyprinus carpio*), drum (*Aplodinotus grunniens*), suckers (Catostomidae), and gar (*Lepisosteus* spp.).

According to a 1986 study, creel averages showed that the catch of crappie and white bass had declined to negligible levels. Smallmouth bass catches had declined while Kentucky bass catches had dramatically increased. White bass populations have shown an overall decline since impoundment. No specific trends were noted for other species. To restore crappie populations in the reservoir, stocking was initiated by the TWRA in 1990. Stocking

of walleyes occurred in the reservoir until 1988 to offset declines in the native walleye population.

4.3 WATER QUALITY

Extensive physical and chemical data have been collected on Center Hill Reservoir and the larger tributary streams at several sampling stations. These stations are considered to be representative of the entire water body and include the major tributaries. Center Hill Reservoir exhibits a trophic gradient ranging from slightly mesotrophic in the main channel of the reservoir to eutrophic in the major embayments. This may be a result of land-use changes and more efficient domestic wastewater treatment in the drainage basin. The water in Center Hill Reservoir is generally suitable as a high-quality water source.

Center Hill Reservoir is a deep, temperature-density stratified storage reservoir with long hydraulic residence times during the stratification period. Stratification in the reservoir occurs from mid-spring (March) until mid-fall (November). During the period of thermal stratification, depletion of dissolved oxygen occurs below the epilimnion in the major embayments with large inflows and in the metalimnion (thermocline) and benthic zones of the main channel. The oxygen depletion is caused in part by the nutrient loading coming into the reservoir from the tributary streams in the Caney Fork River watershed, which contributes to the overall enrichment of the reservoir. The sources of nutrients include agricultural activities, urban-residential runoff, and various wastewater treatment plants whose effluents enter flowing streams. The amount of nutrients can also contribute to the presence of algal blooms, which can cause oxygen depletion.

The upper stratum of water contains oxygen above the recommended level of 5.0 milligrams per liter (mg/L), as specified by the Tennessee Department of Environment and Conservation (TDEC), and is able to support the aquatic organisms that are present. In general, the water quality in Center Hill Reservoir is adequate to support aquatic life; however in the deeper strata during the time of reservoir stratification, low dissolved oxygen conditions occur. Metals, primarily iron and manganese can occur in high concentrations, and can stay in solution during anaerobic and/or stratified conditions; this situation can pose potential problems for downstream water users, and aquatic organisms during hydropower releases. Further, due to anaerobic conditions at depths greater than 15 to 25 feet when the reservoir is stratified, desirable aquatic life is confined to the upper layers of water.

4.4 WETLANDS

The fluctuations in pool elevations (20 feet annual average) and the generally steep banks inhibit the growth of most native shoreline aquatic and wetland plants. Plants that would normally grow in water along the shoreline would be completely stranded in the fall and totally submerged in the spring. Consequently, only a few annual, weedy species are able to take advantage of this type of environment and virtually no significant vegetated wetland areas have developed below the power pool elevation at 648 feet NGVD. Because of the ability to endure partial inundation yet also grow well on relatively dry land, willows (*Salix* spp.) often thrive at the higher edges of summer pool elevation.

According to the U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps that cover the Center Hill Reservoir area, a few palustrine emergent wetlands are depicted primarily at the head of coves and in the less steeply sloped areas, more commonly in the lower portions (Central Basin portion) of the reservoir. These wetland areas are depicted along the shoreline of the power pool elevation of 648 feet NGVD. However, it is unlikely that substantial areas would meet the criteria for jurisdictional (regulated) wetlands under the Corps 1987 *Wetland Delineation Manual*.

4.5 VEGETATION

The Center Hill Reservoir area can be characterized as having a mixed mesophytic deciduous forest vegetation type. Although this is the climax forest for the region, the natural forests in the vicinity of the project area have several vegetation associations characterized by differences in the composition of the dominant canopy species. These differences are due to disturbances as a result of human activities such as lumbering, farming, and livestock grazing; and to changes in elevation, slope, aspect, and moisture regime. Most of the study area's vegetation had been disturbed considerably by intensive timber harvest operations prior to land acquisition for Center Hill Reservoir and now represents various successional stages. Forest communities along the shoreline of Center Hill Reservoir include upland hardwoods dominated by oak-hickory or beech-maple, red cedar stands in rocky and shallow soil areas, cove hardwoods, and wetland forest.

The upland hardwood vegetation type comprises the largest portion of the forests bordering the reservoir. Although it is the climax forest on uplands and upland slopes, the upland hardwood stands in the vicinity of the reservoir consist of secondary and tertiary growths of two upland hardwoods forest communities: oak-hickory and beech-maple. The upland hardwoods are interspersed with red cedar stands on shallow rocky soils or former agricultural lands that are now undergoing natural secondary biotic succession. Trees commonly occurring within the oak-hickory forest communities include the major oak species such as white oak (*Quercus alba*), black oak (*Quercus velutina*), southern red oak (*Carya falcata*), scarlet oak (*Quercus coccinea*), northern red oak (*Quercus rubra*), chestnut oak (*Quercus prinus*), chinquapin oak (*Quercus muehlenbergii*), and post oak (*Quercus stellata*); and several hickories such as mockernut (*Carya alba*), pignut (*Carya glabra*), bitternut (*Carya cordiformis*), and shagbark (*Carya ovata*). Other common components of this forest community are tuliptree (*Liriodendron tulipifera*), black walnut (*Juglans nigra*), white ash (*Fraxinus americana*), hackberry (*Celtis occidentalis*), winged elm (*Ulmus alata*), American elm (*Ulmus americana*), American beech (*Fagus grandifolia*), and blackgum (*Nyssa sylvatica*). Common understory species associated with this type include flowering dogwood (*Cornus florida*), black cherry (*Prunus serotina*), redbud (*Cercis canadensis*), persimmon (*Diospyros virginiana*), and eastern red cedar (*Juniperus virginiana*). This forest community occurs over a variety of sites ranging from moist, but well-drained lowlands to very dry sites on thinly soiled ridges.

The canopy vegetation of the beech-maple forest communities is characterized by American beech and red maple (*Acer rubrum*) and usually occur in areas that have a relatively high percentage of available soil moisture. Other important species include sugar maple (*Acer*

saccharum), boxelder (*A. negundo*), basswood (*Tilia* sp.), hornbeam (*Carpinus caroliniana*), and yellow buckeye (*Aesculus flava*).

Tertiary upland hardwood stands that have resulted from succession of former crop or pasture fields (old-field succession) are characterized almost completely by tuliptree in the vicinity of the reservoir, along with black locust (*Robinia pseudoacacia*), honeylocust (*Gleditsia triacanthos*), red cedar, tree-of-heaven (*Ailanthus altissima*), persimmon, hackberry, sassafras (*Sassafras albidum*), basswood, red mulberry (*Morus rubra*), sumac (*Rhus* spp.), and elm (*Ulmus* spp.).

Red cedar stands are usually found on areas where soil is thin and fertility is low, although they can also occur in all but the wettest bottomland sites. Although red cedar stands are usually homogenous, red cedars are often intermixed and associated with scrub hardwoods, broomsedge (*Andropogon virginicus*), and herbaceous plants. Red cedar is often the climax stage in plant succession at a site due to soil limitations such as low fertility or thin soils. At some sites, however, red cedar is just a stage in the natural succession to the final hardwood climax typical of the region. Red cedar stands comprise a common forest type located in the vicinity of the reservoir.

Cove hardwood communities occur on deep, fertile, moist soils of upland coves, lower slopes, flats, and creek bottoms adjacent to the reservoir and consist mainly of tuliptree, northern red oak, white oak, black walnut, black cherry, cucumbertree (*Magnolia acuminata*), and black locust. Cove hardwood communities occur on a small percentage of project lands.

Wetland forest communities occur in the lower, more level areas at the head of small creeks and streams that flow into the reservoir adjacent to the shoreline at or upslope of the 648-foot NGVD elevation. Due to the variations in pool elevation, the growth of most submerged and emergent native vegetation below summer pool is inhibited. Common trees comprising these communities include black willow (*Salix nigra*), alders (*Alnus* spp.), sweetgum (*Liquidambar styraciflua*), cottonwood (*Populus deltoides*), sycamore (*Platanus occidentalis*), green ash (*Fraxinus pennsylvanica*), red maple, boxelder, hornbeam, and sugarberry (*Celtis laevigata*).

4.6 THREATENED AND ENDANGERED SPECIES

A review of the databases maintained by TDEC, Division of Natural Heritage (TDNH), indicates recorded occurrences of federally- and state-listed endangered and/or threatened species of conservation concern in the vicinity of the Center Hill Reservoir. However, these species are historically recorded as being present outside the 18,220-acre normal summer pool of Center Hill Reservoir.

The impoundment of Caney Fork River to form Center Hill Reservoir altered the original flowing-water habitat of the river and its tributaries to a standing water, lacustrine habitat unsuitable for aquatic species requiring riverine habitats. As a result, species that require swift-flowing habitat do not occur in the reservoir.

Bald eagles (*Haliaeetus leucocephalus*) are often winter visitors to the reservoir area and have been observed feeding at the reservoir. Reportedly, bald eagles have recently attempted

to nest at a location within the reservoir project area. It does not appear that any young were fledged.

A list of rare plant and animal species known to occur in DeKalb, Putnam, Warren, and White Counties that are classified as endangered or threatened by the USFWS and protected by the Endangered Species Act of 1973, or are state-listed species of conservation concern and protected by Proclamation of the TWRA, is presented in Appendix 5.

4.7 RECREATION

One of the project's purposes is to meet existing and projected recreation needs for the region. Center Hill Reservoir is a major recreational resource for middle Tennessee. The significant increase in population of the region and the proliferation of residential development in the area has placed a high demand on the recreational resources of the reservoir and surrounding area. Accessibility is a major factor influencing the use of the reservoir and recreation demand is greatest at the dam and at highways crossing the reservoir. Fishing, sightseeing, pleasure boating, and swimming are all main attractions on the reservoir.

The Nashville District operates nine public recreation areas and has thirteen secondary access points on the reservoir's shoreline. Facilities offer a variety of recreational uses, including boating, fishing, swimming, camping, picnicking, and hiking. Eight commercial marinas located on the reservoir provide a wide range of services including fishing supplies, pleasure boating, houseboats, water skiing, restaurants, overnight accommodations, and other related activities. Other than Corps recreation areas and commercial marinas, several outgrants have been made to state, educational, recreational, and group camp concerns.

The 5,928-acre Edgar Evins State Park is situated approximately four miles south of I-40 (Exit #268) along both sides of the reservoir near the dam. Facilities located at the park include cabins, a campground, picnic shelters, boat ramps, a full-service marina, and nature trails.

Rock Island State Park, located at the falls of the Caney Fork River at the upstream terminus of the reservoir, is an 883-acre state park adjacent to the TVA Great Falls Dam. In addition to land leases from TVA, the park is comprised of 165 acres outgranted from the Corps. Facilities utilized at the park include cabins, a campground, picnic shelters, boat ramps, a full-service marina, recreational facilities and nature trails. Activities include camping, picnicking, swimming, fishing, boating, hiking and, interpretive walks.

A unique resource in the Center Hill Reservoir project area is the Joe L. Evins Center for Crafts located on a 560-acre tract of land. The Craft Center serves as a nucleus for craft activities for the Appalachian region.

The TWRA, under a license from the Corps, conducts an active fish and wildlife program on lands and waters not under an outgrant or otherwise developed. Much of this land is situated on steep hills and atop high bluffs that is not easily accessible but is suitable for certain wildlife management programs.

4.8 CULTURAL RESOURCES

Section 106 of the National Historic Preservation Act of 1966 (NHPA) requires that Federal agencies take into account the effects of its undertakings on historic properties included in or eligible for listing in the National Register of Historic Places. In accordance with 36 CFR 800.16(y), the proposed activity is an undertaking by definition; however, it is an undertaking with no potential to affect historic properties. Project documentation was provided to the Tennessee State Historic Preservation Officer (SHPO) during environmental scoping.

4.9 HEALTH AND SAFETY

Public safety at Center Hill Reservoir is a primary concern. Center Hill Reservoir is located within a one-hour drive of a major metropolitan area (Nashville, Tennessee), and receives heavy visitation. Annual visitation is almost 4 million. This high number of visitors results in intense use of the reservoir and recreation areas.

Buoys are used to mark the reservoir's primary water safety hazards, such as the dam, rocks, shallow areas, and swim areas. Navigation buoys mark some points where water depth is a concern. Marinas are marked with slow, no wake buoys. Boaters are encouraged to follow safe-boating practices and be alert for underwater hazards such as submerged stumps, logs, and rocks.

Park rangers patrol the project to provide visitor assistance and ensure public safety. Law enforcement agreements with the DeKalb County Sheriff's Department provide additional patrols for public safety by law enforcement officials. The TWRA patrols the reservoir for boating safety.

Park rangers provide educational programs to local schools and civic groups on a variety of reservoir-related topics including water safety. The visitor center has safety exhibits and water safety brochures available. News releases and newsletters are issued to encourage the public to practice safety during their visit to the reservoir.

Since its impoundment in 1949, approximately 97 drownings have occurred at Center Hill Reservoir. Activities of the victims included swimming, falling from boats, diving or jumping into the water, falling in while bank fishing, riding personal water craft, and children that were left unattended.

The Corps has an environmental program to provide protection of natural resources and safety for visitors and workers. The Environmental Assessment and Management (TEAM) guide manual and the Environmental Review Guide for Operations (ERGO) are the primary resources used; however, all Federal, state and local laws are followed. The Corps staff includes an environmental protection specialist to monitor the environmental program.

There are no known permanent health assessments or advisories for the reservoir.

4.10 SOCIOECONOMICS

The social and economic influence of Center Hill Reservoir probably extends beyond the boundaries of the four counties of DeKalb, Putnam, Warren, and White adjacent to the reservoir. However, since the proposed permanent reallocation of water supply storage in the reservoir would primarily affect the residents of DeKalb and Putnam Counties, the focus of this section is on those two counties.

4.10.1 Population

Both DeKalb and Putnam Counties have experienced population growth during the past 20 years, and are expected to continue to increase in population as shown on the following table.

Current, Historical and Projected Populations for DeKalb and Putnam Counties			
Census Year	DeKalb County	Putnam County	Total Population
1980	13,589	47,690	61,279
1990	14,410	51,568	65,978
1997	15,801	58,264	74,065
2000	15,998	60,452	76,450
2005	16,660	63,858	80,518
2010	17,291	67,128	84,419
2015	17,931	70,276	88,207
2020	18,577	73,308	91,885

4.10.2 Economics

The two-county area maintains a relatively diversified employment base with manufacturing, retail trade, and health care as the primary industries in terms of employment. Other major industries in the two-county area include accommodation and food services, administration and support services, construction, wholesale trade, and transportation. As of 1996, the total civilian labor force in the two-county area totaled 39,960 (8,699 in DeKalb, 31,261 in Putnam); this number is approximately 18% more than the 1990 census. In 1996, the unemployment rate for DeKalb County was less than 4.7%, down from 7.0% in 1990. The unemployment rate in Putnam County was 7.3%, up from 5.6% in 1990. As of 1994, the per capita income level in DeKalb County was \$17,086 (\$13,292 in 1989). The per capita income level in Putnam County in 1994 was \$17,962 (\$14,456 in 1989). The percent of persons living below the poverty level in DeKalb County in 1993 was 19.4%; in Putnam County, it was 16.9% in 1993.

4.11 LAND USE / AESTHETICS

The irregular shoreline of Center Hill Reservoir is approximately 415 miles in length at maximum flood pool (elevation 685 feet NGVD) and broken by numerous embayments, inlets, coves, and creeks. The reservoir is surrounded by a series of ridges and hills with hardwood forests growing to the water's edge. There are no areas of flooded, dead timber within the reservoir. The shoreline is composed of gravel, rubble, boulders, and limestone bluffs. A mixture of mud and rocks characterize the reservoir banks in the upper tributaries. The configuration of the shoreline does not differ appreciably with changes in the pool level changes due to its steepness, which varies from 20 to 30 percent slopes to sheer bluffs.

The shoreline of Center Hill Reservoir is protected by the perimeter operational lands acquired under the Joint Interagency Acquisition Policy. The acquisition policy guideline was the 700-foot NGVD contour plus additional lands deemed necessary to avoid paying excess severance or incidental damages due to isolation. The Policy provides an opportunity for Corps personnel to fulfill the management objective of protecting the quality of the visual resources and the views of the reservoir. Under the guidelines of the Policy the extent of modifications to the area are limited, thereby reducing or avoiding the impact of the quality of the visual resource and providing the visitor an opportunity to enjoy the undisturbed visual resource that the reservoir provides. Other management objectives include implementing visual enhancement projects to improve area entrances and providing scenic vistas. These lands also serve as buffers and are able to trap nutrients and other pollutants before they enter the reservoir.

As described in Section 4.7, the Nashville District developed nine public recreation areas and thirteen secondary access points on the reservoir's shoreline. There are eight commercial marinas occupying approximately 703 acres of land and water at the reservoir. Several outgrants have been made to state, educational, recreational, and group concerns, including two state parks and the Appalachia Center for Crafts.

The proliferation of second homes and retirement homes constructed on the surrounding lands above the line acquisition since impoundment, and especially within the last decade, have a strong visual impact on the reservoir. Development of the surrounding land for residential purposes is expected to continue to increase.

4.12 TRANSPORTATION

Major roadways in the vicinity of Center Hill Reservoir include Interstate Highway 40 (I-40) and U.S. Highway 70 (U.S. 70). East-west access is provided by I-40 to the northern portions of the reservoir, U.S. 70 approximately midway through the length of the reservoir, and U.S. 70S to the southern portions of the reservoir. Tennessee Route 56 provides the primary north-south access through the reservoir area. These are supported by numerous state and county roadways that provide direct access to Center Hill Reservoir and the associated recreational areas.

The Nashville & Eastern Railroad (NERR) provides rail transportation to the area. No public transportation systems are available in the project area. Neither Center Hill Reservoir, nor Caney Fork River and its tributaries, are used for commercial navigation.

4.13 AIR QUALITY

The study area encompasses portions of these four counties: DeKalb, Putnam, White, and Warren. Air emission sources within the study area consist of a mix of industrial, commercial, and residential stationary sources, plus mobile sources (cars, trucks, etc.).

The counties in the study area are considered in attainment with national ambient air quality standards for which attainment designations have been issued.

5.0 ENVIRONMENTAL CONSEQUENCES

5.1 PHYSIOGRAPHY

5.1.1 Proposed Action: Water Supply Storage Reallocation

Physiography would not be impacted by the Proposed Action.

5.1.2 No-Action Alternative

The No-Action Alternative would have no impact to the physiography.

5.2 AQUATIC RESOURCES

5.2.1 Phytoplankton

5.2.1.1 Proposed Action: Water Supply Storage Reallocation

Due to the Proposed Action, relatively minor water level fluctuations (up to 0.5 foot) might occur during extremely dry years. Phytoplankton typically occupy open water areas away from the shallows, and should not be affected by the minor fluctuation. During extremely dry years, phytoplankton densities would be expected to be lower than in normal years due to reduced nutrient input from local runoff.

5.2.1.2 No-Action Alternative

The No-Action Alternative would result in no change to phytoplankton.

5.2.2 Benthic Invertebrates

5.2.2.1 Proposed Action: Water Supply Storage Reallocation

During extreme drought conditions, water level could drop by 0.5 foot or less. During these periods, there could be certain areas of the littoral zone that are dewatered, potentially leaving less mobile benthic macroinvertebrates stranded where they could perish. However, when the water levels drop and bottom areas are exposed, some invertebrates will burrow deeper into the substrate where conditions are suitable for their existence. In addition, the surface area of the bottom of the reservoir that could be exposed (dewatered) for short periods of time is very small and insignificant compared to the overall area of the reservoir that provides habitat for invertebrates. This condition is not expected to negatively impact the overall invertebrate community of the reservoir.

5.2.2.2 No-Action Alternative

The No-Action Alternative would not change existing conditions for benthic macroinvertebrates.

5.2.3 Fisheries

5.2.3.1 Proposed Action: Water Supply Storage Reallocation

Reallocation of storage for water supply could potentially impact the fisheries component of the aquatic ecosystem during periods of drawdown. Many species present in Center Hill Reservoir utilize the shallow littoral zone of the reservoir as a primary location to carry out their life cycle. The littoral zone is where the young of many fish species, including sunfish, crappie, and bass, forage for invertebrates and smaller fish, and where the majority of the fish spawning occurs. Many game species present in the reservoir create nests to spawn, and water fluctuations could negatively impact the reproductive success of several species. However, very few fish construct nests in extremely shallow water where the nest could be affected by a maximum drawdown of 0.5 feet during extreme drought. Further, water levels affected by water supply withdrawal would be expected to be lowest during late summer or fall, well after the prime period for fish spawning. It has been shown that water level fluctuations in deep, steep-sided reservoirs like Center Hill Reservoir have little effect on sports fisheries except during the spawning season. The Nashville District will continue to cooperate with the TWRA to maintain stable water levels for a two-week period when the water temperature is optimum (65-70 degrees Fahrenheit) for the onset of fish spawning. This generally occurs during the April-May time period. Overall, impacts to fish reproduction by water supply withdrawal during extreme drought conditions are expected to be minor.

5.2.3.2 No-Action Alternative

The No-Action Alternative would not change existing conditions for fisheries resources.

5.3 WATER QUALITY / PHYSICAL AND CHEMICAL CONDITIONS

5.3.1 Proposed Action: Water Supply Storage Reallocation

Chemical constituents such as heavy metals that are bound in the lake bottom sediment could be released during the times when the reservoir level fluctuates during water supply withdrawal as well as during normal annual drawdowns. However, the reservoir littoral zone already experiences exposure of the sediment when the water level is lowered annually as part of the current reservoir operation plan. Therefore, no substantive changes to overall water quality are expected from reallocation of storage for water supply. Ongoing patterns of thermal stratification and development of anaerobic conditions in water deeper than 15 to 25 feet would continue.

Secondary adverse impacts to water quality would occur during M&I users' construction of new water intakes, when sediments could be disturbed and result in increased turbidity. However, the effects would be localized and short-term.

5.3.2 No-Action Alternative

The No-Action Alternative would not change existing water quality conditions.

5.4 WETLANDS

5.4.1 Proposed Action: Water Supply Storage Reallocation

The current operation of the lake, with significant fluctuations in the lake level, is such that few wetland areas exist along the shoreline. Wetlands would not be expected to be affected by implementation of the Proposed Action. Rather, any wetlands that may exist in the project vicinity would likely be impacted by extreme drought conditions unrelated to water supply withdrawals.

5.4.2 No-Action Alternative

The No-Action Alternative would not result in a change to wetlands in the project area.

5.5 VEGETATION

5.5.1 Proposed Action: Water Supply Storage Reallocation

The Proposed Action would not affect the natural vegetation in the project area.

5.5.2 No-Action Alternative

The No-Action Alternative would not result in a change to vegetation in the project area.

5.6 THREATENED AND ENDANGERED SPECIES

5.6.1 Proposed Action: Water Supply Storage Reallocation

The Proposed Action would not have an adverse impact on threatened and endangered species in the project area. The small lake level fluctuation caused by the Proposed Action would not adversely impact any bald eagles that use the reservoir. The USFWS concurred with this finding by letter dated May 16, 2000.

5.6.2 No-Action Alternative

The No-Action Alternative would not result in a change in existing impacts to threatened and endangered species in the project area.

5.7 RECREATION

5.7.1 Proposed Action: Water Supply Storage Reallocation

Implementation of the Proposed Action could affect existing recreational activities at certain locations and times of the year, mainly in shallow areas in late summer or fall. The expected 0.5-foot drawdown resulting from the Proposed Action would not significantly hinder navigation for boaters except during extreme drought periods in some already shallow areas.

5.7.2 No-Action Alternative

The No-Action Alternative would have no impact to recreation in the area.

5.8 CULTURAL RESOURCES

5.8.1 Proposed Action: Water Supply Storage Reallocation

By letter dated May 15, 2000, the Tennessee Historical Commission determined that there would be no National Register of Historic Places listed or eligible properties affected by this undertaking. (Appendix 6)

5.8.2 No-Action Alternative

The No-Action Alternative would have no impact on cultural resources.

5.9 HEALTH AND SAFETY

5.9.1 Proposed Action: Water Supply Storage Reallocation

Implementation of the Proposed Action would provide M&I water users with a safe and reliable supply of water.

Although occurring rarely, a drawdown of 0.5 foot below the normal operating range of the lake would require boaters to be more alert to underwater hazards that may be exposed, such as submerged stumps, logs, and rocks, with the lower lake elevation.

Hazardous, toxic, or radiological waste that might be present in the project area is not expected to be impacted by the Proposed Action.

5.9.2 No-Action Alternative

The No-Action Alternative would not have any impact on the health and safety concerns beyond those that currently exist.

5.10 SOCIOECONOMICS

5.10.1 Proposed Action: Water Supply Storage Reallocation

The proposed reallocation of storage in Center Hill Reservoir would entail M&I users making a one-time purchase of storage from the project, along with the requirement to make annual payments for their pro-rated share of the joint operation and maintenance costs of the project and their pro-rated share of any major repair and/or rehabilitation costs. The annual payments for operation and maintenance are calculated only for those project features necessary to provide storage of water as are any major repairs and/or rehabilitation. These do not include items such as recreation and power plant maintenance not considered necessary for providing water storage.

Reallocation of storage for water supply would provide a dependable volume of water for M&I withdrawal that would be guaranteed during the 50-year drought on a 98 percent dependability. Purchases of storage from Center Hill Reservoir would be similar to other water storage contracts in-place nationwide with M&I users and would not result in unfair or inequitable treatment of local users or their customers in comparison with other parts of the nation.

Current estimates of the initial costs of storage for each of the identified M&I users are:

- City of Cookeville, TN - \$3,000,000
- City of Smithville, TN - \$55,000
- DeKalb Utility District, TN - \$1,000,000
- RiverWatch Resort, LLC, TN - \$100,000

Estimates of annual O&M payments for each of the identified M&I users for Fiscal Year 2000 are:

- City of Cookeville, TN - \$10,000
- City of Smithville, TN - \$600
- DeKalb Utility District - \$2,000
- RiverWatch Resort, LLC - \$200

This would translate into an approximate average monthly cost for a typical family of four of \$0.25. It is assumed that utilities would spread the initial purchase of storage over the next 30 years and that they would equitably distribute the cost increase among customers on a pro-rated basis (i.e., in proportion to water usage); the cost per user is assumed to be dependent on the number of users. Since there are large quantity differences among water users, small users (such as households) would experience dollar increases greater than the average.

The cost to the M&I users is based upon the higher of the following:

1. Updated-Joint-Use Cost of Storage – The updated cost of the dam and reservoir less all specific costs such as hydropower, recreation, etc.
2. Hydropower Benefits Foregone – The benefits from hydropower generation that are lost due to the water supply reallocation.
3. Hydropower Revenues Foregone – The loss of revenues to the Federal government due to storage being reallocated to water supply.
4. Cost of Replacement Power – The cost to replace the hydropower benefits foregone. When reallocating from the hydropower pool the cost of replacement power is equivalent to the cost for hydropower benefits foregone.

In addition to the increased cost of water for each user, impacts from the Proposed Action would include lost hydropower benefits and lost revenue from hydropower generation. Hydropower is generated at Center Hill Reservoir as water is available within the constraints of other purposes including flood storage and water quality. Hydropower losses provide the basis of establishing the cost of storage in Center Hill Reservoir and are partially offset by

return flows from M&I withdrawals as these return flows are added back into the inflow hydrograph for Center Hill Reservoir.

Lost hydropower constitutes a loss of benefits to the users and a loss of revenue to the U.S. Treasury, as power generated at Center Hill Reservoir is marketed through the Southeastern Power Administration (SEPA) of the U.S. Department of Energy (DOE) to various utilities, with receipts from power sales going into the U.S. Treasury. The annual loss of hydropower benefits to the hydropower users due to a 1.0 mgd withdrawal at Center Hill Reservoir would be \$15,547. The average annual loss of revenue due to a 1.0 mgd withdrawal at Center Hill Reservoir would be \$4,653. The relatively small amount of power lost must be supplied from alternative energy sources, which would likely have higher costs to produce the same amount of power than at Center Hill Reservoir. This added cost would be spread among all electrical power consumers in a multi-state area, much as the added costs of water described above are distributed in a much smaller area. The small cost that would be added to an individual consumer's electric bill due to reallocation of storage at Center Hill Reservoir would be essentially unnoticeable. However, the amount the M&I user will pay for storage is based on the highest of the above four costs and this amount will go into the U.S. Treasury.

To be eligible for purchase of storage for M&I purposes, withdrawal from a Corps of Engineers reservoir must be the lowest cost alternative for meeting the user's needs. Therefore, implementation of the Proposed Action would result in the smallest cost increase to customers of the M&I users needing additional water. Further, because three of the M&I users on Center Hill Reservoir already have infrastructure (intakes, treatment plants, pipelines, etc.) in place or under development (City of Cookeville, City of Smithville, and RiverWatch Resort), there would be no additional costs for these items as there would be with alternative water sources.

The proposed reallocation would likely result in a more dependable source of water for M&I users than would other alternatives. In general, ground water is not available in sufficient quantities in middle Tennessee to meet the needs of M&I users. Surface impoundments are expensive and difficult to implement due to environmental concerns, and costs to mitigate the environmental impacts may increase development costs to unreasonable levels. In addition, design treatments to ensure a reliable source of water during dry periods would be a consideration in karst topography.

Indirect impacts of reallocation of storage from Center Hill Reservoir would likely contribute to the continued growth of communities supplied from Center Hill Reservoir, along with environmental, cultural, and socioeconomic impacts resulting from such development. Communities surrounding Center Hill Reservoir are experiencing significant growth already, and provision of a reliable source of water would remove one possible limiting factor to continued growth. However, water supply is just one of many factors that influence development patterns, and available water sources alone would not stimulate development. Minor socioeconomic losses could result from lower water levels and reduced recreation on Center Hill Reservoir during extreme drought periods and the 0.5 foot increased drawdown contributes slightly to that. However, these periods would be very infrequent and of generally short duration and the small drawdown is such that those impacts should not be significant.

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires Federal Agencies to consider whether their actions would result in disproportionately adverse impacts to minority and/or low-income populations. Because the Proposed Action would have effects spread equitably across the entire economic spectrum of the community, there would be no disproportionate impacts to minority or low-income populations.

5.10.2 No-Action Alternative

Under the No-Action Alternative, M&I users with existing intakes and those proposing new intakes in Center Hill Reservoir would be forced to find alternate sources of water that would have higher costs than use of Center Hill Reservoir. This would result in additional construction of facilities that would provide a short-term stimulus to local economies. However, over the long-term, the effects would likely be restricted growth and development opportunities, as water becomes a limiting factor. This would displace development to other areas. Consumers would likely be faced with higher water bills than under the Proposed Action. Alternate sources of water may also be less reliable than Center Hill Reservoir, and the reduced reliability may require periodic curtailment of certain water uses. Conversely, under the No-Action Alternative, there would be no impacts to hydropower generation or recreation at Center Hill Reservoir.

The No-Action Alternative is not expected to result in disproportionate adverse impacts to minority or low-income populations.

5.11 LAND USE / AESTHETICS

5.11.1 Proposed Action: Water Supply Storage Reallocation

The Proposed Action would not have any adverse impact on existing land uses of the Center Hill Reservoir project. Lowering of the pool elevation exposes aesthetically displeasing banks; however, the visual effect that would occur as a result of the Proposed Action with the 0.5-foot drawdown would be substantially less than that which occurs during power production or annually during drawdown and probably not noticeable. Land uses off project lands may be subjected to continued development pressures with provision of adequate and reliable water sources.

5.11.2 No-Action Alternative

The No-Action Alternative would have no impact to existing land use or aesthetics of the Center Hill project. If no water storage were to be reallocated to M&I users, development pressures related to growth could be restricted, thus reducing secondary impacts. Alternatively, development pressures may continue if reliable sources of water (other than Center Hill Reservoir) were to be developed.

5.12 TRANSPORTATION

5.12.1 Proposed Action: Water Supply Storage Reallocation

The Proposed Action would not have any adverse impacts to transportation or other traffic safety-related issues. No new roads would be built or need to be upgraded as a result of the Proposed Action.

5.12.2 No-Action Alternative

This alternative would not directly result in a change in existing roadways, traffic levels or patterns, or safety issues.

5.13 AIR QUALITY

5.13.1 Proposed Action: Water Supply Storage Reallocation

No direct changes in emissions are expected as a result of the Proposed Action. Therefore, air quality permitting and emission standard regulations are not applicable to the project. Indirect changes in emissions resulting from growth patterns that in part have created the need for the Proposed Action would likely continue. These, however, are subject to regulation under the Clean Air Act. The Proposed Action is considered consistent with programs for maintaining compliance with ambient air quality standards.

5.13.2 No-Action Alternative

The No-Action Alternative would have no impact to existing air quality.

6.0 ENVIRONMENTAL COMMITMENTS

The Corps will continue to employ the Best Management Practices (BMPs) associated with the operation of Center Hill Reservoir. Of particular importance is the maintenance of a stable reservoir pool level during the fish-spawning season, and during the time when the recreation use of the reservoir is at its maximum. Examples of BMPs are presented in the following table:

Impact	Mitigation Measure(s)	Objective
Low water levels negatively impacting reproductive success of several fish species	Hold water levels stable during 2-week period when water temperature is optimum for fish spawning	Avoid disruption to fish spawning/reproduction success
Degradation of water quality conditions for tailwater fishery	Minimum of one unit of hydropower generation for one hour every 48 hours from June 1 to November 30 Install and operate various features (hub baffles, supplemental air supplies, etc) on all three hydropower units	Improve water quality conditions for the tailwater fishery Improve release water dissolved oxygen

7.0 AGENCY COORDINATION AND ENVIRONMENTAL COMPLIANCE

Coordination of the proposed water reallocation at Center Hill Reservoir included issuance of a public notice as part of the scoping process (see Appendix 6). In addition, the draft EA is being circulated for agency and public review. Compliance with environmental laws and regulations required for the Proposed Action are identified below.

7.1 CLEAN WATER ACT

Compliance with Section 404 of the Clean Water Act is required for discharge of dredged or fill material into the waters of the United States, including adjacent wetlands. Typical activities requiring Section 404 permits include:

- site development fill for residential, commercial, or recreational developments,
- construction of revetments, groins, breakwaters, levees, dams, dikes, weirs, and intake structures, and
- placement of riprap and road fills.

A Public Notice is distributed to all known interested persons, and to agencies with jurisdiction by law or special expertise. The Corps performs a public interest review, evaluating all comments and information received during the comment period and evaluating the proposal under the Environmental Protection Agency's (EPA) Section 404(b)(1) Guidelines. A permit is issued unless the proposal is found to be contrary to the public interest.

Reallocation for storage of water supply at Center Hill Reservoir is not subject to regulation under the Clean Water Act, and existing intakes have already been approved under Section 404. However, the Department of the Army permits under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act may be necessary in connection with future individual M&I withdrawals. If so, these applications will be processed in accordance with regulations in effect at that time.

7.2 FLOODPLAIN MANAGEMENT

Executive Order (EO) 11988 (May 24, 1977) outlines the responsibilities of Federal agencies in the role of floodplain management. In accordance with this EO, the Corps is required to evaluate the potential effects of actions on floodplains, and does not undertake actions that directly induce growth in the floodplain, unless no practical alternative exists. Construction of structures and facilities on floodplains must incorporate flood proofing and other accepted flood protection measures. Agencies must attach appropriate use restrictions to property proposed for lease, easement, right-of-way, or disposal to non-Federal public or private parties.

The Proposed Action would indirectly support continued growth of communities supplied from Center Hill Reservoir, but would not necessarily directly or indirectly induce growth in the floodplain. Communities surrounding Center Hill Reservoir are already experiencing

significant growth, and provision of a reliable source of water would remove one possible limiting factor to continued growth.

7.3 FISH AND WILDLIFE COORDINATION ACT

The Corps is required to coordinate water resource projects with the USFWS and TWRA under the Fish and Wildlife Coordination Act (FWCA) (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). As an operation and maintenance action, coordination was initiated with the scoping notice for the proposed reallocation. Per a letter dated May 16, 2000, the USFWS stated that any potential impacts would be negligible in regard to fish and wildlife resources. (Appendix 6). The draft EA is being sent to both agencies for review.

7.4 ENDANGERED SPECIES ACT

The Endangered Species Act (ESA) requires the determination of possible effects on or degradation of habitat critical to Federally-listed endangered or threatened species. This assessment examines these issues through review of occurrence records of plants and animals that are on Federal and state lists, and a review of the project area for the presence of the types of habitats that could support listed species. These investigations did not indicate the presence of any listed threatened or endangered species or supporting habitats that would be impacted by the Proposed Action. Thus, the Corps has reached a “no effect” determination concerning endangered species impacts of the proposed reallocation. The USFWS concurred with this finding in the above mentioned letter.

7.5 NATIONAL HISTORIC PRESERVATION ACT

The National Historic Preservation Act requires consideration of the effects of Federal undertakings on historic properties. The Act also requires Federal agencies to provide the Advisory Council on Historic Preservation an opportunity to comment on undertakings through the process codified in the Council's regulations (36 CFR 800). In compliance with this requirement, by letter dated May 15, 2000, the Tennessee SHPO determined that the proposed water storage reallocation would have no effect upon NRHP-listed or NRHP-eligible properties.

7.6 HAZARDOUS, TOXIC AND RADIOLOGIC WASTE

Hazardous, toxic, and radiological waste that might be present in the project area is not expected to be encountered or impacted by the Proposed Action.

7.7 ENVIRONMENTAL JUSTICE

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, was signed on February 11, 1994. The order requires Federal agencies to promote “nondiscrimination in Federal programs substantially affecting human health and the environment.” In response to this direction, Federal agencies must identify and address disproportionately high and adverse human health or

environmental effects of their programs, policies, and activities on minority and low-income populations.

During preparation of this assessment, the two-county project area was evaluated to identify the minority and low-income populations in the project area. The minority residents in DeKalb County and Putnam County represent about 2.6% and 4.1% of the total population, respectively, based on the 1996 census. The minority population consists of representatives from African-American, Hispanic, American Indian, Eskimo, Asian, and Pacific Islander cultures. The census figures do not provide information on the local level of detail for the project area; therefore it is not possible to identify locations with a preponderance of low-income or minority residents. It is assumed that the low-income and minority residents are distributed throughout the counties in the project area.

The final step in the environmental justice evaluation process is to evaluate the impact of the project on the population and to ascertain whether target populations are affected more adversely than are other residents.

- The potentially negative impact of the project would be the increases in the water rates that could be imposed by the municipalities and water districts using storage and withdrawing water from the reservoir. The water rates could increase as a result of the project since the Nashville District must begin to charge municipalities, water districts, and industries for water storage in the reservoir. It is assumed that M&I users would pass on the increased cost of water proportionate to water usage such that no component of the population would be disproportionately affected.
- The positive effect of the project would be to ensure a continuous, uninterrupted supply of finished water to meet the needs of M&I customers, while enjoying growth and prosperity in the region.
- The requested users would all receive the benefits of the storage without regard to income or race.

7.8 CLEAN AIR ACT

The EPA defines ambient air in 40 CFR, Part 50, as “that portion of the atmosphere, external to buildings, to which the general public has access.” In compliance with the Clean Air Act (CAA) and the 1977 and 1990 Amendments (CAAA), EPA has promulgated ambient air quality standards and regulations. The National Ambient Air Quality Standards (NAAQS) were enacted for the protection of the public health and welfare. To date, EPA has issued NAAQS for six criteria pollutants; carbon monoxide, sulfur dioxide, particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers, ozone, nitrogen dioxide, and lead. Areas that are below the standards are in “attainment,” while those that equal or exceed the standards are in “non-attainment.”

The CAA and CAAA require the Corps to comply with all applicable parts of these acts and applicable standards. The project area in DeKalb, Putnam, Warren, and White Counties is currently in attainment for air quality. The Corps’ Proposed Action would not impact the

attainment status of these counties and would be in compliance with the CAA Conformity Rule.

8.0 SCOPING AND PUBLIC CONCERNS

8.1 PUBLIC INVOLVEMENT

Preparation of the EA included agency and public notification of the intent to implement a Proposed Action, and an opportunity for agency and public review and comment on the Proposed Action prior to agency decision making. A combination Public Notice and scoping letter was issued on January 7, 2000, which described the project alternatives. The letter was sent to local, state, and federal governmental agencies with responsibilities for activities within the study area or those that have an interest in the project. An amended Public Notice/Scoping Letter was issued January 24, 2000. Comments from the scoping process are listed below.

8.2 SCOPING RESPONSES

The following responses were received regarding the January 7, 2000 public notice:

- The City of Cookeville, Tennessee requested an increased withdrawal from the 15.0 mgd to 20.0 mgd.
Corps, Nashville District Response: The amended Public Notice/Scoping Letter addressed this increase. The increase has been evaluated in the Corps' Reallocation Report and in this EA.
- The DeWhite Utility District responded that they received the notice in error, instead of the DeKalb Utility District.
Corps, Nashville District Response: The amended Public Notice/Scoping Letter was sent to the DeKalb Utility District.
- The State of Tennessee requested full disclosure of costs and impacts of any fees relating to the proposed water supply reallocation.
Corps, Nashville District Response: A copy of the EA will be sent to the State upon its completion.
- The Tennessee Historical Commission responded that no National Register of Historic Places listed or eligible properties would be affected by this undertaking.
- The U.S. Fish and Wildlife Service responded that the existing and proposed withdrawals would result in very small reductions in water availability; their opinion is that the potential impacts would be negligible to fish and wildlife resources and the public use thereof.

The following letter was received in regard to the draft “Reallocation Report for Water Supply Storage on Center Hill Reservoir, Tennessee” issued January 2000:

- The Southeastern Power Administration (SEPA) responded with two issues of concern: the proposed amount of water storage reallocation being within the Nashville District Engineer’s discretionary reallocation authority and review of the methodology used in determining revenue collected and applied to Power debt repayment to offset impacts of reallocation.

Corps, Nashville District Response: These issues are addressed in the full Water Supply Storage Reallocation Report.

The above responses are provided in their entirety in Appendix 6. There are no unresolved issues.

9.0 CONCLUSIONS

The Corps of Engineers manages water supply contracts for M&I users withdrawing water from agency reservoirs throughout the United States under Public Law 78-534, and has more than 240 contracts in place. The Nashville District has a directive to enter into water storage contracts with the current and future M&I users in the vicinity of Center Hill Reservoir (and other reservoirs throughout the District). The Nashville District has completed an evaluation of the anticipated needs of the M&I users and has determined that there is storage in the reservoir that can be reallocated to meet those needs without seriously impacting the authorized purposes of the reservoir. This EA has addressed potential impacts of the Proposed Action, as well as the No-Action Alternative as follows:

Proposed Action

the Proposed Action would provide M&I water users with a safe and reliable supply of water, while not significantly impacting flood control and hydropower uses, authorized purposes of Center Hill Reservoir

the Water Storage Reallocation Alternative would allow M&I users to meet existing and future water requirements in a cost-effective manner

the Proposed Action would establish a share of the operation, maintenance, repair, and replacement costs of the Center Hill Reservoir to be paid by M&I users

the approximate average monthly cost for a typical family of four would be insignificant, about \$0.25

the Proposed Action is environmentally sensitive to the resources in the area and would not significantly or cumulatively impact any natural or cultural resources or other elements of the human environment

the reservoir drawdown that would be experienced is expected to be about 0.5 foot, which is in the normal operating range of the reservoir

No-Action Alternative

this Alternative does not comply with Public Law 78-534

the M&I water users would still be required to pay for finished water withdrawn from Center Hill Reservoir

growth and prosperity of the region could be restricted if alternative sources of water are more costly than withdrawals from the reservoir

environmental impacts of development of alternative water supplies for each M&I user would likely be more adverse than under the Proposed Action

development of alternative water supplies would likely be more expensive than under the Proposed Action

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APPENDIX 1

PHYTOPLANKTON INFORMATION

APPENDIX 2

BENTHIC INVERTEBRATES INFORMATION

APPENDIX 3

FISH INFORMATION

APPENDIX 4

WATER QUALITY INFORMATION

APPENDIX 5

LIST OF RARE SPECIES BY COUNTY – DEKALB, PUTNAM, WARREN, AND WHITE

APPENDIX 6

SCOPING DOCUMENTATION